The shriveled USA: Representing time-space in the context of metropolitanization and the development of high speeds

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Abstract

On the one hand the present globalisation process has only been made possible through a reduction in time-distances allowed by high speeds, and particularly through the development of air transport. On the other hand the metropolitanization process seen as the urban counterpart of globalisation is deeply associated with the development of air platforms. Understanding distances between places is a fundamental task for the geographer, while the representation of distances constitutes one of the major functions of cartography.
Among the types of maps invented to represent time-space, the anamorphoses were supplemented with time-space relief cartography in the 1990s. This paper proposes a representation of the time-space relief of the USA considering terrestrial and air modes. This last point constitutes a key innovation among this type of cartography, giving the possibility to build a representation of global time-space. The metaphors associated with the images proposed are then discussed evoking the shrinking, the crumpling and, finally the shrivelling of time-space. The shrivelling metaphor renders account of the complicated contraction/dilatation movement that high speeds provoke on space and allows for a rich interpretation of the time-space relief map of the USA in the perspective of the processes of globalisation and metropolitanization.

Keywords

Time-space cartographic representation; globalisation; metropolitanization ; shrivelling.

Introduction

On the one hand the present globalisation process has only been made possible through a reduction in time-distances allowed by high speeds, and particularly through the development of air transport. On the other hand the metropolitanization process seen as the urban counterpart of globalisation is deeply associated with the development of air platforms. Both phenomena are intrinsically linked to the formation of distances, and especially time-distances.
Understanding distances between places is a fundamental task for the geographer, while the representation of distances constitutes one of the major functions of cartography.
Among the types of maps introduced to represent time-space anamorphoses were supplemented with time-space relief cartography in the 1990s. We propose in this paper a

representation of the time-space relief of the USA considering terrestrial and air modes. This last point constitutes a key innovation among this type of cartography giving the possibility in the future to build a representation of global time-space. The metaphors associated with the images proposed will then be discussed evoking the shrinking, the crumpling and finally the shrivelling of time-space.

1. Representing distances

We want to develop in this paper a reflection and a proposal on the representation of the contemporary global time-space, in the light of the double movement of metropolitanization and globalisation.
To understand the present global space it is necessary to underline the major role played by high speeds in the structuring of metropolitan spaces. These high speeds have allowed the development of communications on a global scale. But, in the mean time, high speeds operate a dramatic selection of places.
While this movement highlights the high places of global communication, the secondary networks and spaces remain present in the interstices. A key point in the formation of global time-distances is the fact that these secondary networks are disqualified when compared to the main high-speed networks.
In view of these phenomena the recent literature insists on the differentiation of space where global functions can be located in the close spatial neighbourhood of spaces of dereliction and exclusion (Graham and Marvin 2001) and on inequalities in space favouring largest centres (Knowles 2006).

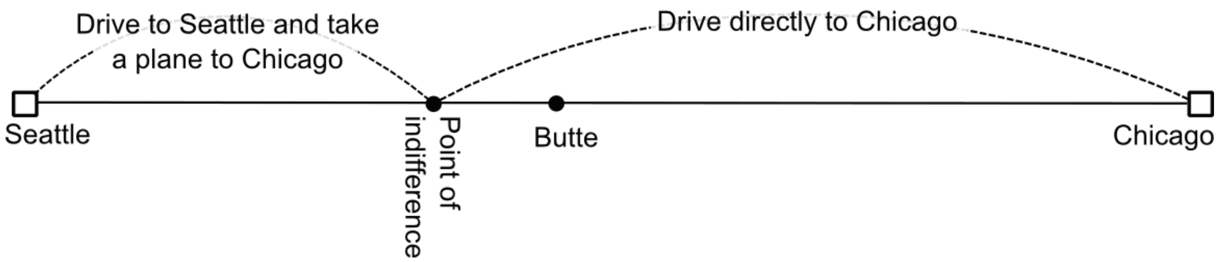

Figure 1 : the phenomenon of spatial inversion

But how to represent this complicated set of networks and relations in space? To tackle this question means considering the broader perspective of the representation of distances. In this field Bunge has stated that basically two ways are available either "representing complicated distances on simple maps, or representing simple distances on complicated maps" (Bunge 1962).
In his classical example of the complicated relations in space generated by contemporary transport means, Bunge considers the movements from intermediary space to higher level cities with a trip from somewhere in Montana to the metropolis of Chicago. The articulation of transport modes, here cars and planes, implies in this example that the shortest path in time space takes a completely different shape beyond and after a particular point of indifference. Leaving from Butte would mean driving directly to Chicago, while starting from somewhere closer to the Pacific coast involves a trip by car to Seattle followed by a flight. This phenomenon of spatial inversion that follows an intuitive logic from a transport perspective provokes a disturbance in the order of proximities. If we refer to Cauvins's formalism (Cauvin

1996), while the Rocky Mountains are located between Seattle and Chicago in chorotaxic space –the usual geographic space- their position in functional space is different: in the transport space it is Seattle that stands between the Rocky mountains and the Great Lakes. The identification of the phenomenon of spatial inversion constitutes a key justification of the research of new representations of time-space that would render this complicated set of distances. It is a direct call to complicate the map in order to allow the representation of distances that would be simpler to read.

In this perspective, time-space anamorphic cartography is the first proposal in which one moves the locations in order to better respect time-distances. An example is given by Shimizu showing the contraction of Japan due to the development of the high-speed train networks between 1962 and 1992 (Shimizu 1992). In the field of the representation of distances, anamorphosis belongs to the type of cartography defined by Bunge as simpler distances on a complicated map. Two elements of information on time-distances can be read from such a representation: the overall space contraction and the local deformations produced by high-speed lines. If the new transport networks had been characterised by homogeneity and anisotropy the shape of the external borders of the country would have remained unchanged.. Only size would have been reduced. All the distortions from the usual and conventional shape of Japan indicate directions privileged by the shape of the networks. The literature on networks has abundantly expressed the idea that modern transport provokes heterogeneousness in space (Dupuy 1991; Castells 1996; Graham and Marvin 2001; Knowles 2006).

This model, however, is subject to limitations (L'Hostis 1996; L'Hostis 2000; L'Hostis 2003; L'Hostis 2007). The major criticism of the application of anamorphosis to the representation of distances is the fact that if two locations, for instance two cities, are getting closer due to a new transport link, this does not mean that the space in between is also gaining in accessibility. Toll motorways are examples of the “tunnel effect” of some infrastructures where the limited access points reduce the accessibility gains to a set of subspaces, and is not distributed evenly along the line (Plassard 1976). This phenomenon is even more pronounced in the case of high-speed rail (Murayama 1994; Mathis 2007) and is one of the major characteristics of air transport (Haggett 2001). Furnishing an illustration of this limitation, the phenomenon of spatial inversion cannot be read from the anamorphic map because of the principle of the preservation of the order of proximities which can be found in most methods developed in the literature (Shimizu 1992; Spiekermann and Wegener 1994; Clark 1999; Kotoh 2001).

Displacing the locations on the map is not the only way in which distances can be represented. The idea of drawing the transport lines between places in such a way that different distances are shown was introduced in the 1980’s (Plassard and Routhier 1987; Tobler 1997). In the example proposed by Tobler, location of cities and network nodes remains unchanged, as compared to their usual cartographic position. The length of roads between the nodes is displayed in the form of a spring, the intensity of the tension indicating the sinuousness of roads unevenly distributed in this mountainous area in western Colorado. In this model one can obtain the information on the difficulty of linking two places by reading the *visual length* of the links. The notion of visual length was introduced (L'Hostis 2003) to render account of the capacity of a reader of a map to extract the information on the length of a route from the analysis of the shape of the path. A straight segment can be converted in kilometres through a direct use of the scale, while a sinuous curve will indicate a longer road. This principle is used in the spring map to express the idea of privileged and handicapped directions.

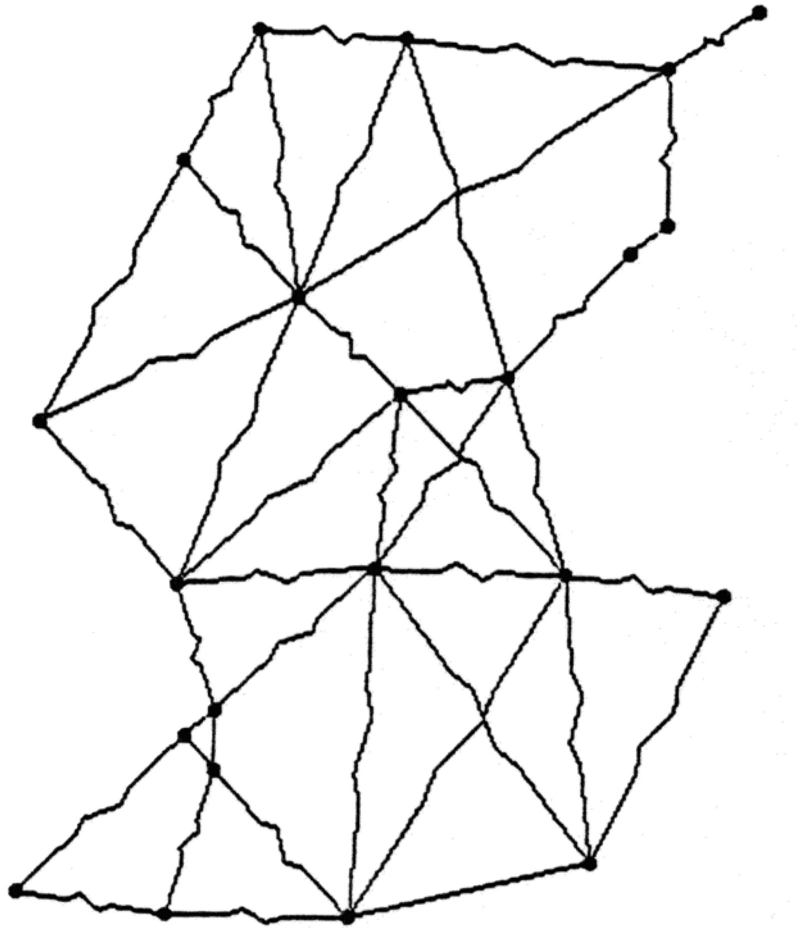

Figure 2 : spring map of roads in western Colorado

The spring map model can indicate the shortest directions in space. Being a non-Euclidean representation, it displays the idea that the shortest paths often differ from the straight line. In this perspective, it constitutes a possible proposal to the call for non-Euclidean geography (Golledge and Hubert 1982; Müller 1982). More recently, but in the same direction, a model has been formulated to introduce a three dimensional surface that allows the representation of different speeds in urban space (Hyman and Mayhew 2004).

Sharing a principle of construction similar to that of the spring map, the time-space relief map was introduced in the 1990s (Mathis, Polombo et al. 1993; L'Hostis 1996; Mathis 1996). This type of representation preserves the location of places but exploits the resources of the third dimension to draw the various speeds and the corresponding time-distances in a multimodal network. All the previous representations of this kind have been based on terrestrial networks, including road and high-speed rail. In this paper we will develop the model in the direction of long-distance air transport with the aim of exploring time-distances on a global scale.

2. Air and road modes as major inter- and intra-metropolitan transport systems

Globalisation, considered together with metropolitanization as its urban counterpart, is being made possible by the development of efficient, long-haul and short-haul transport systems. If metropolises can be defined as urban entities that communicate on a global scale, the air mode constitutes the major passenger transport system associated with globalisation (Sassen 1991; Haggett 2001). Indeed, the equipment of metropolises with airport infrastructure, the number of flights and destinations available or the air distances are often used as indicators of the position of cities in the global competition (Rozenblat and Cicille 2003; Taylor 2004; Grubesic and Zook 2007). Nevertheless, the development of the air mode during the 20th century and beyond has not lead to the replacement of other slower transport systems. Each transport mode has developed inside its own space of predominance, with fierce competition in the margins. On the scale of metropolitan spaces, the road system can be considered as the major mode, even if regional specificities can be stressed (Kenworthy and Laube 1999). The overall picture of mobility involves two distinct levels with the agglomeration or local level dominated by car and the longer distance dominated by air. This typology has to be put in correspondence with the functioning of urban systems having intra-metropolitan and inter-metropolitan components associated with privileged transport modes. In order to complete the analysis, this picture has to be enriched marginally with the development of other transport systems, urban public transport and high-speed rail, each of them operating as a complement to, rather than in substitution for cars and planes.

We want to address the question of the time-distances between metropolises. Our model is based on average speeds that determine the time-distances on the map. We have proposed considering the distances in kilometres between city centres as relevant measures of inter-metropolitan trips. From this dataset, the next step is to measure the time spent with the air transport mode in order to produce one or several average speeds. Nevertheless, establishing the speed allowed by the air mode constitutes a methodological issue.

We have considered on figure 3 a sample of inter-metropolitan direct flights inside the USA in 2007. Distance as the crow flies has been measured between urban centres, while the time spent refers exclusively to the commercial schedules proposed by the airline companies for direct flights. The figure shows a distribution of speeds ranging between 650 kph and 150 kph that is strongly related to the straight line distance but also depends on other factors.

One the one hand, an example of an existing short distance inter-metropolitan relation by air is given between New York and Philadelphia with 65 minutes necessary for linking two airports for an intercity distance of 145 km (89 mi).

On the other hand, the speed of the relation between New York and Los Angeles is approaching the cruise speed of typical jet planes around 850 kph.

The explanation of this distribution can be found in several factors. Firstly, the schedules provided by airlines include the time spent by planes on the ground before take-off and after landing which does not depend on the overall distance and can be considered as fixed durations that are specific to the air mode. Secondly, on shorter distances, airlines use specialised planes, sometimes even turboprops, which are characterised by maximum speeds lower than that of planes that one can find on long-haul routes.

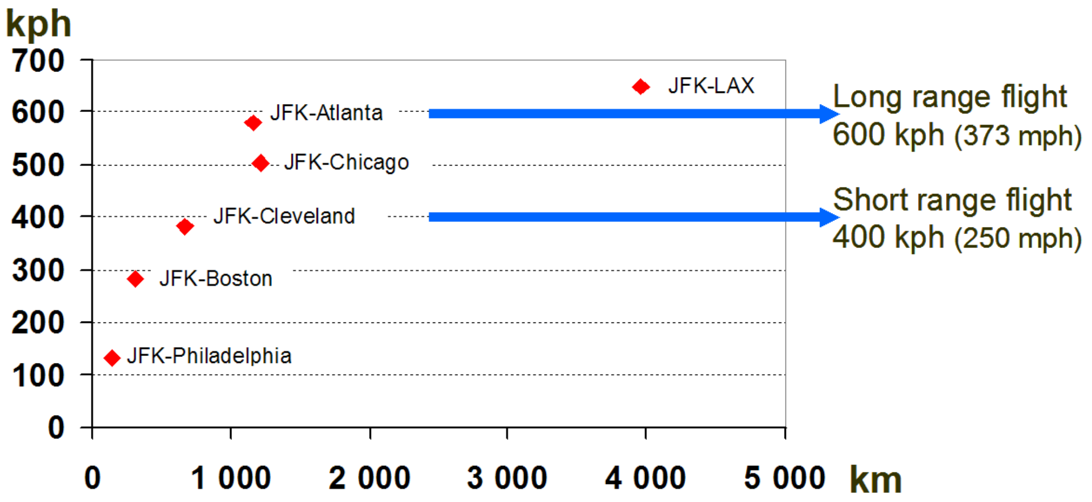

Figure 3 : time-distances by air between metropolises, the issue of speed

These two elements contribute to the dispersion of speeds in relation to the intercity distance. But in order to complete the analysis, another factor has to be discussed. If we consider distances produced by intercity relations, the initial and terminal parts of the trips, beyond the airport and inside the metropolitan space, are not included in the dataset. If this element were introduced it would contribute even more to widening the gap between the maximum and the minimum speeds in the distribution. We can then consider that the present analysis of timetables proposes one step towards a correct understanding of time-distances by air. Further developments could be proposed in this direction.

In order to account for this phenomenon of dispersion of speeds we propose to introduce two distinct average speeds, one for long distances close to the maximum, and one for shorter relations. Figure 3 shows these two measures with 600 kph for long-haul and 400 kph for short-haul flights.

3. A multimodal model of time-distances

Relief time-distance cartography proposes a relevant representation of distances produced by a multimodal network (L'Hostis 1996; Mathis 1996). In the present application we consider the following couples associating a transport mode and an average speed:

- Long-range air at 600 kph
- Short-range air at 400 kph
- Dual carriageway at 100 kph
- Highway at 70 kph

Two networks allowing four different speeds are used to produce the map. The air network is modelled with two speeds corresponding to long and shorter distance relations, while the speed on the road network is related to the quality of the infrastructure. Most of the inter-metropolitan relations are served by the interstate highway network, and only a few links depend on the use of trunk roads. This differentiation leads to the identification of a network at 100 kph and a network at 70 kph composed of trunk roads.

While on the multimodal terrestrial network of France the differential between the fastest mode with high-speed trains at 220 kph and the slowest modes with the regular road system 60 kph (L'Hostis 2000) was 3.14, the differential reaches the value of 8.5 in the United States time-space. For this reason the image proposed has a much sharper appearance than the previous representations.

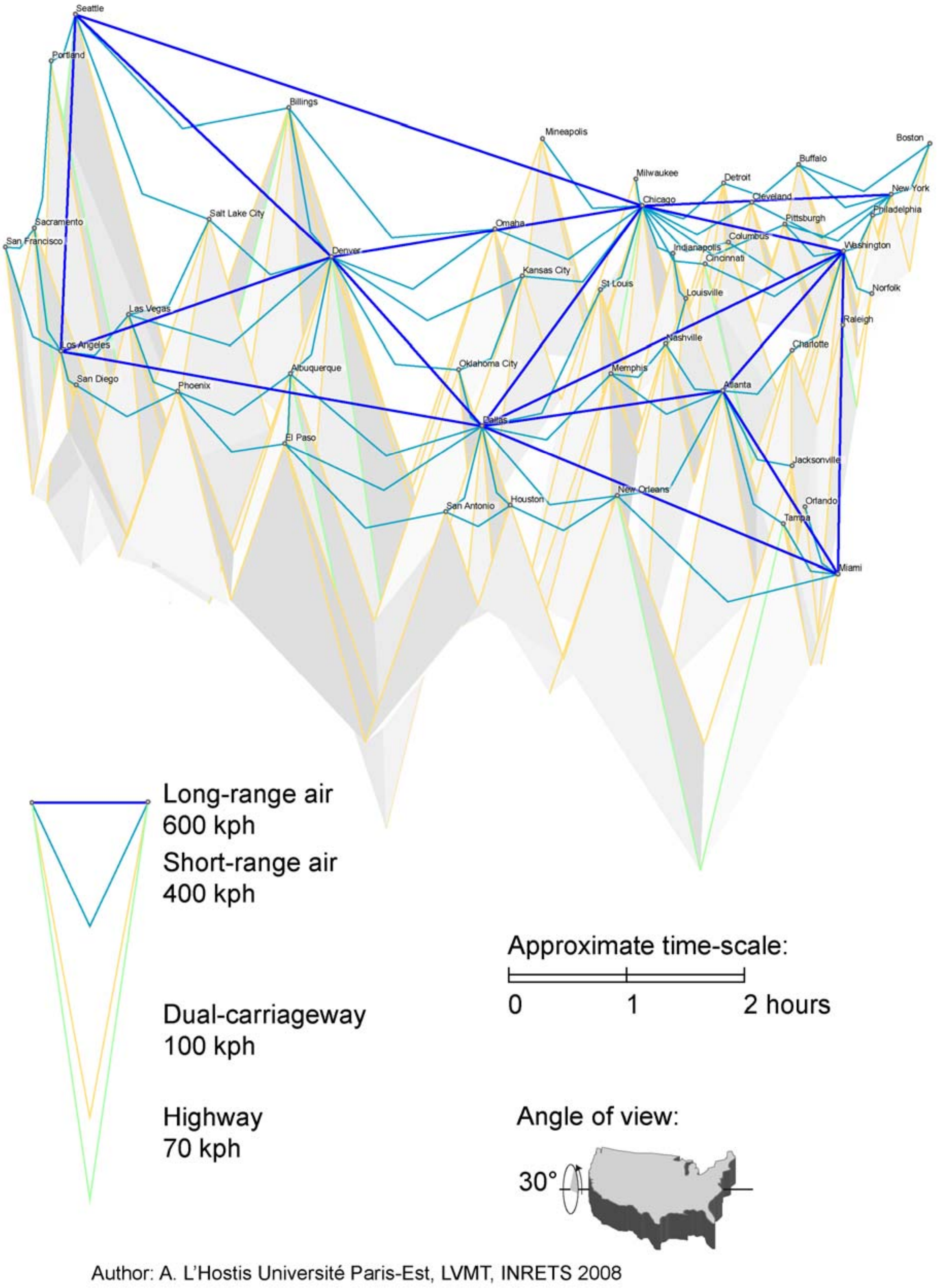

Figure 4: Multimodal "shrivelling" time-space relief map of the USA[1]

The geographical space considered on the map includes the continental part of the USA, Alaska not included. In this space the major cities are considered with metropolitan areas of more than 1 million inhabitants. This list is completed with a few particular cities in order to improve the readability of the cartography. In this perspective, a particular attention is given to the border cities that help us to recognise the usual shape of the country, and to the density of nodes. It is the case with Billings (Idaho) counting 150,000 inhabitants and to a lesser extent to Omaha, Albuquerque and El Paso, which rank just above one million.
The identification of air links is related to the major passenger air flows existing inside the USA. It is worth mentioning here that the geography of the air network is subject to instabilities caused locally by strategies of operators or globally by periods of economic recession. For this reason the time-space is in constant evolution.
The map displays the confrontation between high speeds, accessible through the air transport systems, and the lower speeds of the road network. The angle of view fixed here at 30° permits the reading of the map.
The map expresses the combination of two distinct time-spaces, air and road, that meet at the location of major urban centres. Metropolises appear as nodes that allow for transfer between fast and slow transport systems, between global and local networks. In time-space relief the nodal entities are located at the summit of time-space peaks. This position highlights their role of global/local interfaces. In contrast, the rest of the space is rejected under the plan of the metropolises. The interstices left between the major urban areas associated with fast-transport nodes forms abysses in time-space reflecting their position of disqualified space, when considered in relation with the metropolitan areas.
Let us now go back to the spatial inversion model described by Bunge in figure 1. In order to adapt the model to the present network characterised by a dramatic development of air transport since the 1960s we will consider in Figure 4 the space located between the cities of Seattle and Billings in its relation to Chicago. The reader of the time-space relief map can determine the fastest path through the multimodal network. The fact that the shortest path can involve an initial reverse portion of the trip in order to drive to the closest long distance node, is clearly expressed by the steep slopes of the road network that contrast with the more "direct" links of the air system. If we adapt the example given by Bunge to the present network, for someone living in the region of Butte in Montana, the choice can consist either in driving to Seattle to take a direct flight to Chicago, or driving to Billings and find a connecting flight to Chicago via Denver. In this example the reader of the map can visually add the length of the edges in order to infer a total length that will be proportional to the duration of its trip. This demonstrates that this representation is a time-space map.
Another way to state the property of spatial inversion described by Bunge consists in discussing the idea of "tunnel effect" of fast transport systems mentioned before. The time-space relief map expresses the tunnel effect by representing the fastest links as edges detached from the geographic space and only connected through transport nodes. Tunnel effect refers here to the idea that it is not possible to leave or to access a fast transport system elsewhere than in the connecting nodes. The effect on space is here a crumpling of interstitial areas, while the fast transport entries are getting closer to each other.
The relief time-space map proposes a representation of the spatial inversion where the un-intuitive order of proximities of geographical transport space is made comprehensible.
High speeds reduce time-distances, but high speeds are not available everywhere in space. According to this idea, the relief time-space representation shows both short distances

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[1] A high-quality graphic colour version of this time-space cartography can be downloaded from http://mapnod.free.fr/relief.html

between metropolises and long time-distance outside of the high-speed network.
Beside these positive elements, one must admit that this model of representation suffers from several limitations. Some limitations refer to the way time-distances are considered, while others concern the readability of the cartography. Indeed, congestion is not taken into account and the connection time between modes or between planes is considered equal to zero. These elements constitute perspectives for the development of the model.
Concerning readability, the representation poses a new range of problems that are difficult to tackle. The reader of the map of a country or a continent expects to recognise the overall shape referring to their cartographic culture with the north orientation and other conventional features. By processing strong deformation of the conventional map, time-space relief representation supposes an effort by the reader in order understand the cartography. One can assume, though, that the complicated nature of the representation is in relation with the complicated nature of time-space itself, in which spatial inversion perturbs the conventional Euclidean rules. Seen from above, the shape of the country is unaltered, but then the relief is hardly readable. We have proposed to introduce an angle of view which is relevant to express the shape of the relief without deforming the overall shape too much. Usually, an angle of 30° is used. Nevertheless, because of the high differential between speeds, the representation is highly sensible to the modifications in the angle of view. To tackle this issue, we have explored three dimensional computer representation and animation techniques that can facilitate the reading of the representation (L'Hostis 2003).
The time-space representation proposes a relevant tool for explaining the functioning of transport systems. It also expresses an image of geographic space that is worth commenting. One the one hand, metropolises fostering high-speed nodes occupy the summit of time-space peaks and are closely linked to each other through the high-speed network. On the other hand, the rest of space, the banal non-metropolitanized space, is rejected in time-space valleys and abysses. The overall picture is much in phase with the idea of Graham and Marvin of metropolitanized space as an ‘archipelago of enclaves’, which they depict in their book on ‘Splintering urbanism’ (Graham and Marvin 2001). The representation shows how accessibility between neighbouring metropolises can be of a higher level than the accessibility between a metropolis and its surrounding space supposed to belong to its area of influence. This image of decoupling of spaces proposes a representation of a key feature of contemporary geography.

4. The ‘shrivelling’ metaphor

In geography the rhetoric of world contraction can be considered as a fundamental observation with early references of the ancient Greeks that perceived the evolution of vessel techniques at the time-scale of the life of a human being, and linked it to the reducing of distances between places in the Mediterranean sea (Abler, Janelle et al. 1975; Braudel 1979). In the 19th century already maps of now classical French geography depicted the contraction of the national territory with the improvements in terrestrial transport, while German cartographers mapped the improvement in maritime transport on a global scale showing the reduction in travel times between Europe and the rest of the world (Brunet 1987). More recently, in the domain of theoretical geography, Forer has developed the principle of time-space contraction (Forer 1978).
Nevertheless, criticisms of the contraction model has been made noticeably by Kirsch stating that “space is not “shrinking” but must rather be perpetually recast” (Kirsch 1995). According to Kirsch, the evolution of time-space cannot be seen as a simple contraction or shrinking process. Disagreement to the uniform contraction idea can be found in several geographers works on cartographical developments (Boggs 1941; Abler, Janelle et al. 1975; Haggett 1990). More recently Knowles uses the expression of a “shrunken but misshapen world” to

describe the present time-space where contraction is all but uniform (Knowles 2006). Indeed, the abandon of commercial supersonic flights, the development of congestion and the increasing concern about security in the air transport system are the cause of contradictory movements of convergence and divergence on time-space.

The notion of time-space convergence was introduced (Janelle 1968; Janelle and Gillespie 2004) to show that larger cities benefited more than smaller cities from the contraction of time-space by faster transport means. For Janelle the modernisation of transport systems is seen as a factor of concentration in urban agglomerations. In history, the increase in transport speeds has benefited larger cities more than smaller settlements. According to Christaller's theory of urban hierarchy, large cities are more dispersed in space than smaller ones. Two neighbouring large cities will then be separated by a much longer distance than any two neighbouring smaller cities. Janelle demonstrated that the increase in speed delivers a stronger effect on time-space contraction on long distances than on short distances. The evolution of the system of speeds gives an advantage to the larger cities over smaller ones, a conclusion which is in line with the literature on metropolitanization. The identification of privileged places in the process of space contraction is for Knowles still an idea to be demonstrated in order to challenge misrepresentations of uniform time-space shrinkage (Knowles 2006).

More recently the literature on globalisation (Sassen 1991; Smith and Timberlake 2002; Taylor 2004) has taken as its base the principle of fast communication and transport on a global scale. Only global transport systems have made the present movement of globalisation and the unprecedented concentration of population in major metropolises possible.

The initial discussion on the three-dimensional model presented here considered the terrestrial relief as the space of reference. The expressions *time-space peaks* and *time-space valleys* referred to the relative position of portions of space in the representation. In the time-space deformation following the introduction in the French national space of the high-speed train system (Mathis, Polombo et al. 1993), the development of new high-speed tangential axis was seen as a way to fill up the valleys dug by the introduction of a differential in transport speeds combined with a star shape of the network (Mathis 1996). These initial contributions emphasized the analogy with the terrestrial relief.

Later, the idea of a time-space 'crumpling' was introduced to develop the metaphor (L'Hostis 2000) on a representation of the European space deformed by the high-speed rail network. The image developed is that of the deformation of a shrivelled sheet of paper, an idea of three dimensional treatment of a plane. The metaphor refers to a shortening of some distances while preserving the initial geographical surface. The metaphor of 'crumpling' opposes the two spaces of high and low speeds and suggests a three dimensional geometric construction coherent with the concept behind the representation. It also proposes a rather negative image with the crumpled surface seen as a degradation of the ideal unaltered flat plane. A positive perspective can be built, considering that the crumpled shape, being more compact than the flat surface, allows for shorter paths between locations. The crumpling metaphor gives an evocative image of the bad treatment reserved for interstitial spaces, but is not as expressive of the global contraction of geographical space with the increase in speed.

It is relevant to associate these reflections on the representation of geographic time-space with some recent developments in theoretical physics: the astrophysicist Luminet describes the shape of the universe as crumpled (Luminet 2001) around the idea of multiple folding due to time-space deformation, according to the theory of general relativity. Even if establishing relations between completely different fields invites us to remain cautious (a use of common words is not sufficient to validate a comparison), it is noticeable that both systems of representation are tightly linked to the identification of a maximum speed. Indeed, the light speed is one of the three fundamental constants in physics. Astrophysicists have to compose with the existence of a maximum speed, light-speed on the universal scale, when geographers have to take into account the maximum speed of transport given by the air mode to understand the terrestrial time-space. In order to better understand space, both reflections seem to face the need to build complicated representations that divert radically from common Euclidean geometry.

In a different field, psychoanalysts have been studying the crumpled spaces (Diener 2008) in order to understand the linkages realised in the time-space of dreams, where associations of ideas lead to direct relations between locations that can be very distant in time-space. A *crumpled space*, defined by reference to the astrophysicist Luminet work as "welded on itself by several points" realise this kind of connections (Diener 2008). The analogy goes there much further: in the geographic space, fast transport systems realise direct connection between remote locations, advocating for the development of crumpled time-space cartography, while in the time-space of dreams, direct connections between remote locations constitutes an essential property. The movement of crumpling generates new connections, new proximities that reflect the properties of geographical space and the properties of the time-space of dreams.

In the evolution of the discourse produced on time-space relief, the following step explores a different type of metaphor based on the idea of *shrivelling*. The first use of the word must be credited to Tobler (Tobler 1999) through his commentary on the L'Hostis-Mathis image, when he stated that "the world is shrivelling as it shrinks". We move here from an image of shaping an inanimate entity, an artefact, *crumpling a sheet of paper*, to a principle of natural evolution of a living organism, *the shrivelling of a fruit*. The shrivelling expresses an idea of contraction with deformation of the envelope: the volume decreases while the external envelope keeps its initial surface.

The strength of the metaphor lies in the combination and the linking of two complementary movements of contraction and deformation of the surface. It is the reduction of the volume due to a loss of substance that provokes the deformation of the skin of the fruit. In geographic terms, it is then possible to explain the complicated shape of the map by the global contraction due to high speeds. The model generates forces of contraction along air routes that apply on high-speed nodes, i.e. metropolises. "High speeds and metropolitanization make the world shrivel as it shrinks" would then be a reformulation of Tobler's statement.

It is this reflection on the shape of the earth, and not only on the shape of a single country or a continent, that lead to the necessity of introducing the air mode in the relief representation. Being the global transport mode of reference, the air mode had to be considered: we developed in this paper a proposal for representing global distances and local distances simultaneously. To that extent, the present application on the USA paves the way to a representation of the earth.

From the distribution of world cities and from the description of major air routes and of the intercity terrestrial networks, it would be possible to build a representation of the global time-space. The world would then be seen as a shrivelled fruit. If we follow the metaphor of shrivelling we could consider this evolution as a maturing process. We know that the passion fruit is mature and ready to be eaten when it has shrivelled and its skin has crumpled.

But according to the previous discussion on the differential between global speed and terrestrial speed, the intensity of the shrivelling movement will be much more intense for the global space than for the maturing passion fruit. The sharpness of the time-space peaks bearing the world metropolises will produce an image evoking much less the passion fruit than the chestnut. The metaphor of maturing will have to give place to another figure to render justice to the dichotomy of spaces opposing world cities to the rest.

5. Conclusion and perspectives

The time-space relief map shows the complicated phenomenon of contraction and dilation of

space time due to the coexistence of transport networks with different performances. The entry points to the fast transport systems are getting closer to each other, while the interstitial space is rejected in the third dimension.
The time-space relief map is a solution for the representation of distances through the transport networks – where the straight line in the plane is not the shortest path – a question of major importance in geography.
In addition, the model proposes a rich interpretation in terms of metropolitanization and globalisation processes. Because it is built from the distribution of metropolises and from the shape of the transport network, the shrivelled map constitutes a conceptually relevant representation, from a geographic perspective. The image produced opposes the upper level urban network with metropolises occupying the summit of time-space peaks tightly related to each other and the rest of the geographic space relegated and rejected in time-space valleys and abysses.

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The language barrier prevented the author from fully understanding Tobler’s statement that “the world is shrivelling as it shrinks” until a particular morning of the winter of 2005 when Jules, the 8-year-old son of the author, used the word ‘crumpled’ to describe the shape of a passion fruit he intended to eat. Thanks to Jules.

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